

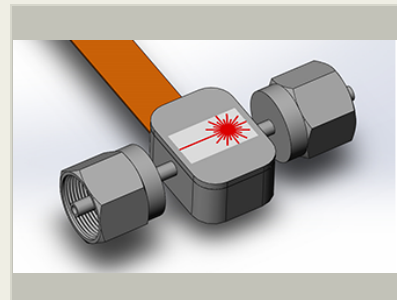
Miniature Integrated-Optic Trace-Gas Sensors for Off-World Science Missions, Phase I

Completed Technology Project (2016 - 2016)



Project Introduction

As miniaturized satellite platforms such as CubeSat increase in capability, they will eventually be deployed to other planetary bodies (e.g., JPL INSPIRE). An important aspect of this technology is the potential for the low-cost (<\$30M/mission) in-situ quantification of off-world resources. Indeed, the recent NEO Trajectory Opportunities Study asked, What is the elemental and mineralogical composition and water content of primitive bodies? while the recent National Research Council Planetary Science Decadal Survey indicated that laser spectroscopy is a key technology that will provide answers via in situ measurement of off-world trace-gas species in various space-flight missions. Towards that end, Physical Sciences Inc. (PSI) proposes to develop an ultra-low Size, Weight, and Power (SWaP) in-situ integrated optical sensor for the sensitive measurement of trace gases, initially water vapor. The novel sensor architecture, based on open-path Tunable Diode Laser Spectroscopy (TDLAS), will serve as a platform for a family of sensors, each able to detect one of the gaseous species of interest to NASA. The proposed project focuses on using novel manufacturing and engineering design concepts to create a sensor measurement head that detects <10 ng/cm³ water vapor in a 1cm optical path as part of a 10g, 1cm³ package. When combined with PSI's integrated electronics, the complete sensor SWaP is expected to be on the order of 500 g, 100 cm³, and <600 mW, nominally 10-100X better than the current state-of-the-art. PSI's Phase I Program objective is a laboratory bench-top demonstration proving the feasibility of the compact packaging design in meeting both the spectroscopic goals and the SWaP needs for future inter-planetary CubeSat missions. This will entail the design and fabrication of an integrated optical water vapor sensor and the experimental demonstration of water vapor measurements with chemical resolution relevant to in situ resource quantification.



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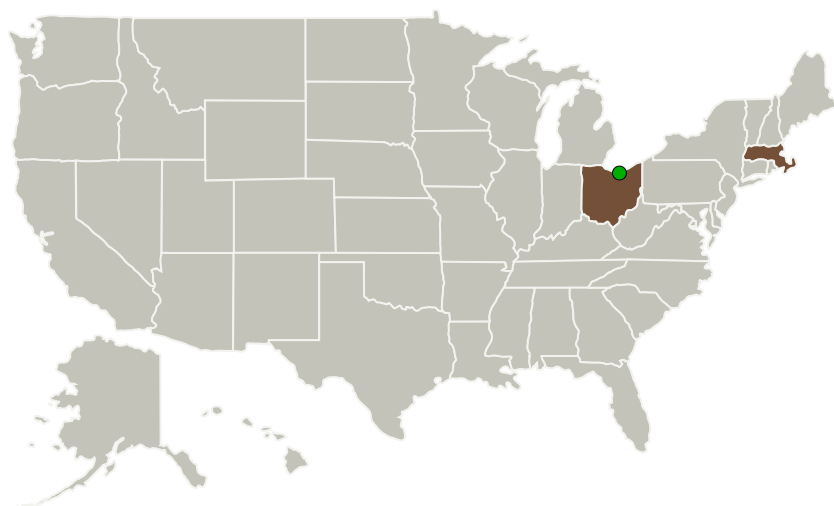
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Physical Sciences, Inc.	Lead Organization	Industry	Andover, Massachusetts
● Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations

Massachusetts	Ohio
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Project Transitions

**June 2016:** Project Start**December 2016:** Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/139895>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Physical Sciences, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

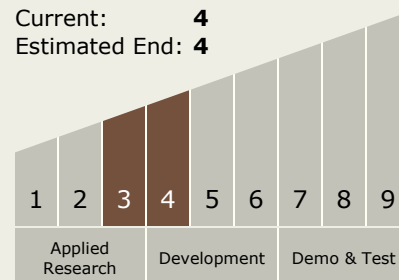
Carlos Torrez

Principal Investigator:

Oscar D Herrera

Technology Maturity (TRL)

Start: **3**
 Current: **4**
 Estimated End: **4**

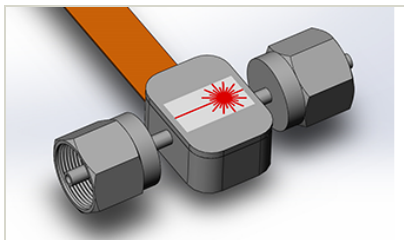


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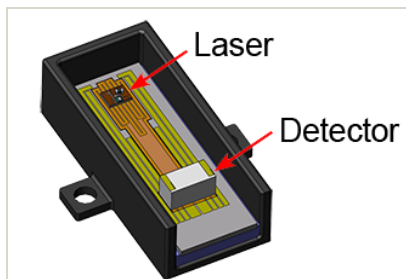


Images



Briefing Chart Image

Miniature Integrated-Optic Trace-Gas Sensors for Off-World Science Missions, Phase I
(<https://techport.nasa.gov/image/127793>)



Final Summary Chart Image

Miniature Integrated-Optic Trace-Gas Sensors for Off-World Science Missions, Phase I Project Image
(<https://techport.nasa.gov/image/126041>)

Technology Areas

Primary:

- TX08 Sensors and Instruments
 - └ TX08.3 In-Situ Instruments and Sensors
 - └ TX08.3.4 Environment Sensors

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System